

Claims

What is claimed is:

1. A method of radially expanding a tubular member, comprising:
positioning an expansion cone comprising a tapered exterior surface and non-tapered exterior surfaces positioned above and below the tapered exterior surface within the tubular member;
defining an annulus between the tapered and non-tapered exterior surfaces of the expansion cone and the interior surfaces of the tubular member;
displacing the expansion cone relative to the tubular member to radially expand and plastically deform the tubular member; and
during the displacement of the expansion cone relative to the tubular member, injecting fluidic material through the non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone into the annulus and conveying the fluidic material through the remaining length of the annulus.
2. The method of claim 1, wherein displacing the expansion cone relative to the tubular member comprises:
pulling the expansion cone through the tubular member using fluid pressure.
3. The method of claim 2, wherein pulling the expansion cone through the tubular member using fluid pressure comprises:
pressuring an annular chamber within the tubular member above the expansion cone.
4. The method of claim 1, wherein displacing the expansion cone relative to the tubular member comprises:
pushing the expansion cone through the tubular member using fluid pressure.
5. The method of claim 4, wherein pushing the expansion cone through the tubular member using fluid pressure comprises:
pressurizing a chamber within the tubular member below the expansion cone.
6. The method of claim 1, wherein the fluidic material is injected through the tapered exterior surface of the expansion cone into a portion of the annulus bounded by the tapered exterior surface.

7. The method of claim 1, wherein the fluidic material is injected through non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone and the tapered exterior surface of the expansion cone into a portion of the annulus above the tapered exterior surface and another portion of the annulus bounded by the tapered exterior surface.

8. A system for radially expanding a tubular member, comprising:
means for positioning an expansion cone within the tubular member;
means for displacing the expansion cone relative to the tubular member; and
during the displacement of the expansion cone relative to the tubular member, means for hydroplaning the tubular member on the expansion cone.

9. The system of claim 8, wherein means for displacing the expansion cone relative to the tubular member comprises:
means for pulling the expansion cone through the tubular member using fluid pressure.

10. The system of claim 9, wherein means for pulling the expansion cone through the tubular member using fluid pressure comprises:
means for pressuring an annular chamber within the tubular member above the expansion cone.

11. The system of claim 8, wherein means for displacing the expansion cone relative to the tubular member comprises:
means for pushing the expansion cone through the tubular member using fluid pressure.

12. The system of claim 11, wherein means for pushing the expansion cone through the tubular member using fluid pressure comprises:
means for pressurizing a chamber within the tubular member below the expansion cone.

13. The system of claim 8, wherein means for hydroplaning the tubular member on the expansion cone comprises:
means for injecting a fluidic material into an annulus between the expansion cone and the tubular member.

14. The system of claim 13, wherein the expansion cone comprises a conical outer surface; and wherein the means for injecting a fluidic material into the annulus between the expansion cone and

the tubular member comprises means for injecting a fluidic material a portion of the annulus above the conical outer surface.

15. The system of claim 13, wherein the expansion cone comprises a conical outer surface; and wherein the means for injecting a fluidic material into the annulus between the expansion cone and the tubular member comprises means for injecting a fluidic material into a portion of the annulus bounded by the conical outer surface.

16. The system of claim 13, wherein the expansion cone comprises a conical outer surface; and wherein the means for injecting a fluidic material into the annulus between the expansion cone and the tubular member comprises means for injecting a fluidic material into a portion of the annulus above the conical outer surface and another portion of the annulus bounded by the conical outer surface.

17. The system of claim 13, wherein means for displacing the expansion cone relative to the tubular member comprises:

means for pulling the expansion cone through the tubular member using fluid pressure.

18. The system of claim 13, wherein means for pulling the expansion cone through the tubular member using fluid pressure comprises:

means for pressuring an annular chamber within the tubular member above the expansion cone.

19. The system of claim 18, wherein the operating pressure of the annular chamber and the annulus are approximately equal.

20. The system of claim 13, wherein means for displacing the expansion cone relative to the tubular member comprises:

means for pushing the expansion cone through the tubular member using fluid pressure.

21. The system of claim 20, wherein means for pushing the expansion cone through the tubular member using fluid pressure comprises:

means for pressurizing a chamber within the tubular member below the expansion cone.

22. The system of claim 21, wherein the operating pressure of the chamber and the annulus are

approximately equal.

23. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
a tubular support member that defines a longitudinal passage;
a tubular expansion cone coupled to an end of the tubular support member that defines a longitudinal passage and one or more radial passages that extend from the longitudinal passage and extend to an outer surface of the tubular expansion cone;
a tubular expansion cone launcher that receives the tubular expansion cone;
a tubular shoe coupled to an end of the tubular expansion cone launcher that defines a valveable longitudinal passage;
an expandable tubular member coupled to another end of the tubular expansion cone launcher; and
one or more cup seals coupled to the tubular support member for sealingly engaging the interior surface of the expandable tubular member.

24. The apparatus of claim 23, wherein the tubular expansion cone comprises a tapered outer surface and a non tapered outer surface; and wherein at least one of the radial passages extend to the non tapered outer surface.

25. The apparatus of claim 24, wherein at least one of the radial passages extend to the tapered outer surface.

26. The apparatus of claim 23, wherein the tubular expansion cone comprises a tapered outer surface and a non tapered outer surface; wherein at least one of the radial passages extend to the non tapered outer surface; and wherein at least one other of the radial passages extend to the tapered outer surface.

27. A method of radially expanding a tubular member, comprising:
positioning an expansion device comprising an exterior expansion surface within the tubular member;
defining an annulus between the exterior expansion surface of the expansion device and the interior surface of the tubular member;
displacing the expansion device relative to the tubular member to radially expand and plastically deform the tubular member; and

during the displacement of the expansion device relative to the tubular member, injecting fluidic material through expansion device into the annulus and conveying the fluidic material through the remaining length of the annulus.

28. The method of claim 27, wherein displacing the expansion device relative to the tubular member comprises:
pulling the expansion device through the tubular member using fluid pressure.

29. The method of claim 28, wherein pulling the expansion device through the tubular member using fluid pressure comprises:
pressuring an annular chamber within the tubular member above the expansion device.

30. The method of claim 27, wherein displacing the expansion device relative to the tubular member comprises:
pushing the expansion device through the tubular member using fluid pressure.

31. The method of claim 30, wherein pushing the expansion device through the tubular member using fluid pressure comprises:
pressurizing a chamber within the tubular member below the expansion device.

32. The method of claim 27, wherein the fluidic material is injected through the exterior expansion surface of the expansion device into a portion of the annulus bounded by the exterior expansion surface of the expansion device.

33. A system for radially expanding a tubular member, comprising:
means for positioning an expansion device within the tubular member;
means for displacing the expansion device relative to the tubular member; and
during the displacement of the expansion device relative to the tubular member, means for hydroplaning the tubular member on the expansion device.

34. The system of claim 33, wherein means for displacing the expansion device relative to the tubular member comprises:
means for pulling the expansion device through the tubular member using fluid pressure.

35. The system of claim 34, wherein means for pulling the expansion device through the tubular member using fluid pressure comprises:
means for pressuring an annular chamber within the tubular member above the expansion device.

36. The system of claim 33, wherein means for displacing the expansion device relative to the tubular member comprises:
means for pushing the expansion device through the tubular member using fluid pressure.

37. The system of claim 36, wherein means for pushing the expansion device through the tubular member using fluid pressure comprises:
means for pressurizing a chamber within the tubular member below the expansion device.

38. The system of claim 33, wherein means for hydroplaning the tubular member on the expansion device comprises:
means for injecting a fluidic material into an annulus between the expansion device and the tubular member.

39. The system of claim 38, wherein means for displacing the expansion device relative to the tubular member comprises:
means for pulling the expansion device through the tubular member using fluid pressure.

40. The system of claim 39, wherein means for pulling the expansion device through the tubular member using fluid pressure comprises:
means for pressuring an annular chamber within the tubular member above the expansion device.

41. The system of claim 40, wherein the operating pressure of the annular chamber and the annulus are approximately equal.

42. The system of claim 38, wherein means for displacing the expansion device relative to the tubular member comprises:
means for pushing the expansion device through the tubular member using fluid pressure.

43. The system of claim 42, wherein means for pushing the expansion device through the tubular member using fluid pressure comprises:
means for pressurizing a chamber within the tubular member below the expansion device.

44. The system of claim 21, wherein the operating pressure of the chamber and the annulus are approximately equal.

45. An apparatus for radially expanding and plastically deforming a tubular member, comprising:
a tubular support member that defines a longitudinal passage;
an expansion device coupled to an end of the tubular support member that defines a longitudinal passage and one or more radial passages that extend from the longitudinal passage and extend to an outer surface of the expansion device;
a tubular expansion launcher that receives and mates with the expansion device;
an expandable tubular member coupled to an end of the tubular expansion launcher; and
one or more cup seals coupled to the tubular support member for sealingly engaging the interior surface of the expandable tubular member.

46. The apparatus of claim 45, wherein the expansion device comprises a tapered outer surface and a non tapered outer surface; and wherein at least one of the radial passages extend to the non tapered outer surface.

47. The apparatus of claim 46, wherein at least one of the radial passages extend to the tapered outer surface.

48. The apparatus of claim 45, wherein the expansion device comprises a tapered outer surface and a non tapered outer surface; wherein at least one of the radial passages extend to the non tapered outer surface; and wherein at least one other of the radial passages extend to the tapered outer surface.

49. A method of radially expanding a tubular member, comprising:
positioning an expansion device within the tubular member;
defining an annulus between the expansion device and the tubular member;

displacing the expansion device relative to the tubular member in a first direction to radially expand and plastically deform the tubular member; and
during the displacement of the expansion device relative to the tubular member, injecting fluidic material through the expansion device into the annulus and conveying the fluidic material through the remaining length of the annulus in a second direction;
wherein the first and second directions are opposite to one another.

50. A method of radially expanding a tubular member, comprising:
positioning an expansion device within the tubular member;
defining an annulus between the expansion device and the interior surface of the tubular member;
displacing the expansion device relative to the tubular member to radially expand and plastically deform the tubular member; and
during the displacement of the expansion device relative to the tubular member, pressurizing the annulus by injecting fluidic material through the expansion device into the annulus.

51. A method of radially expanding a tubular member, comprising:
positioning an expansion cone comprising a tapered exterior surface and non-tapered exterior surfaces positioned above and below the tapered exterior surface within the tubular member;
defining an annulus between the tapered and non-tapered exterior surfaces of the expansion cone and the interior surfaces of the tubular member;
displacing the expansion cone relative to the tubular member to radially expand and plastically deform the tubular member; and
during the displacement of the expansion cone relative to the tubular member, injecting fluidic material through the non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone into the annulus and conveying the fluidic material through the remaining length of the annulus;
wherein displacing the expansion cone relative to the tubular member comprises pulling the expansion cone through the tubular member using fluid pressure; and
wherein pulling the expansion cone through the tubular member using fluid pressure comprises: pressuring an annular chamber within the tubular member above the expansion cone.

52. A method of radially expanding a tubular member, comprising:
positioning an expansion cone comprising a tapered exterior surface and non-tapered exterior surfaces positioned above and below the tapered exterior surface within the tubular member;

defining an annulus between the tapered and non-tapered exterior surfaces of the expansion cone and the interior surfaces of the tubular member;
displacing the expansion cone relative to the tubular member to radially expand and plastically deform the tubular member; and
during the displacement of the expansion cone relative to the tubular member, injecting fluidic material through the non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone into the annulus and conveying the fluidic material through the remaining length of the annulus;
wherein displacing the expansion cone relative to the tubular member comprises:
pushing the expansion cone through the tubular member using fluid pressure; and
wherein pushing the expansion cone through the tubular member using fluid pressure comprises: pressurizing a chamber within the tubular member below the expansion cone.

53. The method of claims 51 or 52, wherein the fluidic material is injected through the tapered exterior surface of the expansion cone into a portion of the annulus bounded by the tapered exterior surface.

54. The method of claims 51 or 52, wherein the fluidic material is injected through non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone and the tapered exterior surface of the expansion cone into a portion of the annulus above the tapered exterior surface and another portion of the annulus bounded by the tapered exterior surface.

55. A system for radially expanding a tubular member, comprising:
means for positioning an expansion cone comprising a tapered exterior surface and non-tapered exterior surfaces positioned above and below the tapered exterior surface within the tubular member;
means for defining an annulus between the tapered and non-tapered exterior surfaces of the expansion cone and the interior surfaces of the tubular member;
means for displacing the expansion cone relative to the tubular member to radially expand and plastically deform the tubular member; and
during the displacement of the expansion cone relative to the tubular member, means for injecting fluidic material through the non-tapered exterior surface of the expansion cone above

the tapered exterior surface of the expansion cone into the annulus and conveying the fluidic material through the remaining length of the annulus;
wherein means for displacing the expansion cone relative to the tubular member comprises means for pulling the expansion cone through the tubular member using fluid pressure; and
wherein means for pulling the expansion cone through the tubular member using fluid pressure comprises: means for pressuring an annular chamber within the tubular member above the expansion cone.

56. A system for radially expanding a tubular member, comprising:
means for positioning an expansion cone comprising a tapered exterior surface and non-tapered exterior surfaces positioned above and below the tapered exterior surface within the tubular member;
means for defining an annulus between the tapered and non-tapered exterior surfaces of the expansion cone and the interior surfaces of the tubular member;
displacing the expansion cone relative to the tubular member to radially expand and plastically deform the tubular member; and
during the displacement of the expansion cone relative to the tubular member, means for injecting fluidic material through the non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone into the annulus and conveying the fluidic material through the remaining length of the annulus;
wherein means for displacing the expansion cone relative to the tubular member comprises:
means for pushing the expansion cone through the tubular member using fluid pressure; and
wherein means for pushing the expansion cone through the tubular member using fluid pressure comprises: means for pressurizing a chamber within the tubular member below the expansion cone.

57. The system of claims 55 or 56, wherein the fluidic material is injected through the tapered exterior surface of the expansion cone into a portion of the annulus bounded by the tapered exterior surface.

58. The system of claims 55 or 56, wherein the fluidic material is injected through non-tapered exterior surface of the expansion cone above the tapered exterior surface of the expansion cone and the tapered exterior surface of the expansion cone into a portion of the annulus above the tapered exterior surface and another portion of the annulus bounded by the tapered exterior

surface.

59. An apparatus for radially expanding and plastically deforming a tubular member, comprising:

a tubular support member that defines a longitudinal passage;

an expansion device coupled to an end of the tubular support member that defines a longitudinal passage and one or more radial passages that extend from the longitudinal passage and extend to an outer surface of the expansion device;

a tubular expansion launcher that receives and mates with the expansion device;

an expandable tubular member coupled to an end of the tubular expansion launcher; and

one or more cup seals coupled to the tubular support member for sealingly engaging the interior surface of the expandable tubular member;

wherein the expansion device comprises a tapered outer surface and a non tapered outer surface; wherein at least one of the radial passages extend to the non tapered outer surface; and wherein at least one of the radial passages extend to the tapered outer surface.